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NEW SHIPPING CONTAINERS for short hauls of ICEPACKED POULTRY

U.S. DEPARTMENT OF AGRICULTURE

Agricultural Marketing Service,
Transportation and Facilities Research Division.

PREFACE

This is one of a number of publications being issued by the Agricultural Marketing Service evaluating new packages, shipping containers, and packing methods for agricultural products. The study on which the report is based is part of a broad program of research to reduce the cost of marketing farm products and to deliver them to the consumer in better condition.

This work on the development of less expensive containers for nearby shipments of fresh poultry was conducted at the Transportation Research Branch station, Transportation and Facilities Research Division, AMS, Fresno, Calif.

Many California processors, container manufacturers and suppliers of packaging materials, wholesalers, and supermarket organizations cooperated in this project. Especially helpful were Alvin H. Douty, president of the California State Poultry Institute; Bob Geyer, Foster Poultry Farms; Dan Martinelli Poultry Company; Reif and Brody Poultry Company; Salinas Valley Poultry Company; Western Turkey Packing Company; ABCO Wire and Metal Products, Inc.; Colorado Fuel and Iron Corporation; Dobeckmun Company, division of the Dow Chemical Company; Grower Containers, division of St. Regis Paper Company; Hinde and Dauch, division of West Virginia Pulp and Paper Company; Hollywood Plastics, Inc.; and Santa Cruz Wire and Manufacturing Company.

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Washington, D. C.

February 1963

SUMMARY

Declining and periodically depressed prices for broiler and fryer chickens led to this study of containers for California poultry in an effort to effect economies in marketing costs.

Researchers of the Agricultural Marketing Service found that almost all the broilers and fryers produced in California were marketed in the State and that 70 percent were sold through stores within 200 miles of the processing plants. Yet, for these nearby deliveries, it was noted that the iced, ready-to-cook poultry was packed in the same conventional wirebound crate which was sturdy enough for shipments of 2,000 miles and more under the most adverse conditions.

Since it was estimated that 40 percent of all the fresh poultry processed in the United States also is marketed within a 200-mile area, research was conducted in 1961 and 1962 to develop and evaluate less expensive containers for short-haul deliveries.

A returnable wirework basket with a polyethylene liner was developed by the researchers. This and three new types of single-trip, moisture-resistant, fiberboard boxes were evaluated in comparison with the conventional crates.

When this report was written, the test baskets had completed 35 round trips from processing plants to retail stores, and still seemed in good condition. Assuming a useful life of 35 trips for the baskets, and making a 10 percent allowance for possible losses, the combined cost per trip for container, packing materials, and direct labor to pack 100 pounds of poultry was found to be 64 cents, compared with equivalent costs of $1.02 for the conventional crate (ordinarily called "box" by poultry people). Costs when the three experimental fiberboard boxes were used ranged from 91 cents to $1.06. These figures exclude the cost of labor for operations not influenced by type of container, and costs for machinery and equipment, overhead, and the like.

In 18 truck shipments of 50 to 450 miles, icepacked chickens in all the types of containers arrived at destination in good condition, with meat temperatures at 33 to 36 degrees F.

The returnable basket required more care in handling than did the crate. However, the polyethylene liner of the basket prevented the entrance of foreign materials, including drainage from overhead, whereas the paper liner in the crate did not give complete protection to its contents. Although the baskets required additional labor for returning to the plant and washing, the extra cost was far outweighed by savings from reuse of the container. Little additional plant space was required by the baskets because, when empty, they could be nested 20 high under an 8-foot ceiling.

Estimates indicated that a small plant processing 500 birds a day for local delivery could save about $2,000 a year by using the returnable wirework basket for its entire production. For a plant that processed 30,000 birds a day, it was estimated that use of the returnable containers for the 30 percent of production that was delivered to regular customers within a radius of 125 miles would save $35,000 a year. Under the same conditions, a large plant with a daily output of 125,000 chickens might save almost $150,000 a year.

The three moisture-resistant fiberboard boxes were well received by the trade. Comments indicated that they were considered attractive and easy to handle. However, of the three boxes, only the full-telescope type, which was more expensive than the crate, completely barred the entrance of fluids seeping down from overhead.

NEW SHIPPING CONTAINERS FOR SHORT HAULS OF ICEPACKED POULTRY

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Transportation and Facilities Research Division,
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INTRODUCTION

Since 1951, the nation's commercial production of broiler and fryer chickens has been steadily increasing. In 1961, a record 1,992 million broilers and fryers were produced. 2/ California, where this study was made, accounted for approximately 3 percent of the total production.

During this decade of increasing production, the general trend in prices received for broiler and fryer chickens was downward. Prices received by farmers nationwide in 1951 for live commercial broilers and fryers averaged 28.5 cents a pound; in 1961, the average price reached a low of 14.2 cents a pound. 3/

Preliminary surveys made in poultry processing plants in California indicated a strong desire by the packers for the development of better, less expensive containers for distributing fresh, ready-to-cook, icepacked chickens as an aid in offsetting the disastrous effects of declining and periodically depressed prices on farmers and the industry. Researchers observed that most of the commercial poultry plants surveyed were near urban areas. In 1961, California plants slaughtered and marketed 225 million pounds of broilers and fryers, mostly for consumption within the State. It was conservatively estimated that over 70 percent of the broiler and fryer production from all California plants was marketed within 200 miles of the processing plant. As a result, the researchers concentrated on the development of shipping containers for delivering icepacked broilers and fryers to local and nearby markets.

Objectives

The objectives of this study were to develop improved and less costly containers; to evaluate new or improved containers developed by container manufacturers; and, in cooperation with poultry processors, to compare the advantages and disadvantages of these containers.

1/ Packaging Research Field Station, Fresno, Calif.

2/ Chickens, Eggs, and Commercial Broilers, Statis. Rptg. Serv., U. S. Dept. Agr., April 1962.

3/ Poultry and Egg Situation, U. S. Dept. Agr., January 1962.

Procedure

In the fall of 1960, a preliminary survey of retail stores in central California provided information that guided this study. The survey produced information on the handling and storage of poultry containers at the stores. Meat managers of 13 stores reported that:

1. All 13 stores received fresh poultry packed in wirebound crates. Most of the poultry was supplied by nearby processors; however, all of the stores occasionally received poultry from other areas of the country.

2. The same packaging procedures and materials were used to ship fresh poultry 2 miles or 2,000 miles. That is, the same amount of packaging expenditure was made for fresh poultry that was packed and shipped across town as for poultry that was in truck transit for 2 or more days.

3. During normal periods, the stores received shipments of fresh poultry two to four times a week, and usually kept from three to five wirebound crates in storage. However, during special poultry sales, 2 or 3 deliveries were made every day, and the number of crates in storage ranged from 15 to 50.

4. The meat departments had storage facilities for fresh dressed poultry that ranged from primitive to very efficient. Most stores had above-floor concrete or metal drainage facilities.

5. Most meat managers expressed neither extreme satisfaction nor dissatisfaction with the wirebound crates. Some butchers thought the crates were hard to handle (they mentioned splinters, difficulties in bending wires when opening, and difficulties of disposal).

During 1960 and 1961, three types of moisture-resistant fiberboard boxes and the conventional wirebound crates were evaluated. Development work on a returnable wirework basket also was begun and carried to a successful conclusion.

Time studies in five poultry packing plants determined the amount of direct labor for packing the various containers. Methods of packing and handling were observed, and costs of labor, containers, and packing materials were recorded. Eighteen truck test shipments that traveled from 50 to 450 miles were made. Inspections were made to measure damage to the product and handling procedures were observed at retail stores.

By following each test shipment from the processing plant to the retail store, observing the handling of the test containers, and making product damage inspections, the research workers were enabled to recommend many design changes and improvements that were later adopted by shippers and container manufacturers.

Comparisons were made of cooling and maintenance of low temperatures of poultry packed in the different containers. Temperatures were recorded also upon arrival at the retail store, to determine whether adequate temperatures were maintained during distribution of the test containers.

CONVENTIONAL WIREBOUND CRATE

The conventional container used by practically all poultry processors is the wirebound crate (fig. 1). This container was used as a standard with which the experimental containers were compared.

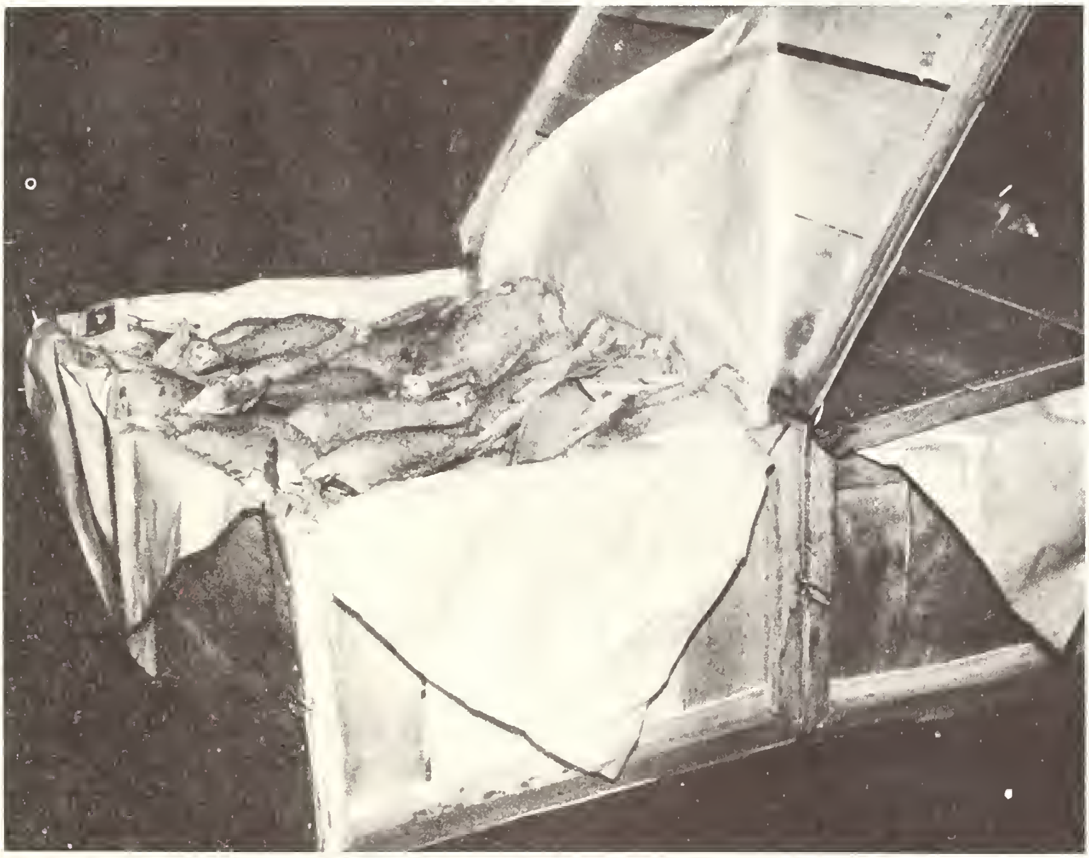

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Figure 1.--Conventional wirebound crate packed with ready-to-cook chickens. Note paper liner.

Description

The inside dimensions of the wirebound crate were 22 by 16½ inches, with a 10- to 11-inch depth. The crates were constructed of four veneer side slats, two on each side; three veneer top slats; three veneer bottom slats; and four 15-gage binding wires. Each end panel consisted of three veneer slats and four cleats. The wirebound crates studied had capacities of 3,630 to 3,993 cubic inches, and held an average of about 65 pounds of poultry. The tare weight of the crates ranged between 5 and 5½ pounds.

Methods of Packing

The wirebound crates were received from the manufacturer preassembled, in knocked-down flat bundles. One man, using a hand tool, set up the containers by opening up the crate and then bending two wire loops that interlocked around the cleats of the end panels. Before the crate was packed, a waxed kraft paper or paper parchment liner was inserted.

Because the tare weights of the crates varied, each crate in the plants studied was weighed before reaching the packing area. Depending on size of the birds, 20 to 30 were packed into each container. In two plants, the workers packed from bins, and in three, from tables.

In one plant, the birds were graded, presized, automatically dropped into bins, and then "place packed" into the crates. Birds weighing between 2 1/4 and 2 3/4 pounds were packed 2 layers deep, two 6-bird rows per layer, for a total of 24 birds per container. Larger birds of 3 pounds and over were packed 2 layers deep, two 5-bird rows per layer, for a total of 20 birds.

In smaller plants, the birds were dumped on a table, graded, and then jumble packed. Usually, 24 birds of mixed sizes were packed in each crate. After the crates were filled, they were put on a scale and weighed. After deductions were made for tare weight of the crate and shrinkage, labels noting net weight, count, and grade were stapled to one end of the container.

Before the crates were closed, 25 to 30 pounds of crushed ice was shoveled on top of the birds (fig. 2). After icing, the containers were moved to the closing area.

In some plants, the wirebound crates were closed manually by interlocking four wire loops on the top lid with four wire loops on the front side of the crate. In others, this operation was performed by a fully automatic machine. The crates were then stacked five high on pallets and transported by hand trucks into the cooling room to await shipment.

Test Shipments

Deliveries of nine shipments of wirebound crates from packing plants to retail stores were observed. All deliveries were made within a distance of 150 miles. The average elapsed time between completion of the pack in the plant and delivery to the stores was 32 hours. This included an average of 23 hours in the holding rooms and 9 hours on refrigerated trucks.

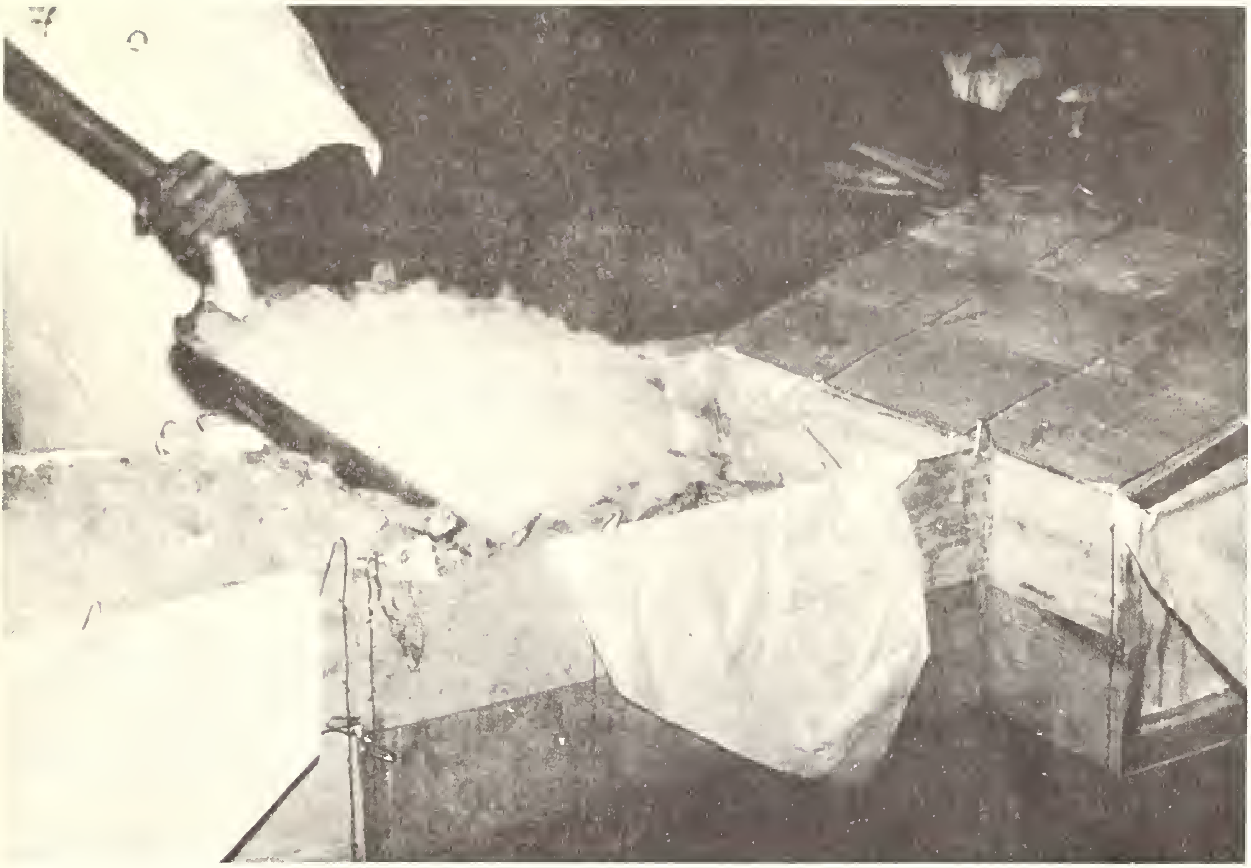

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Figure 2.--Top icing a wirebound crate before closing.

During this time, the average tare weight of the wirebound crates increased from 5.3 pounds to 7.7 pounds as a result of absorption of moisture, and an average of 13 pounds of ice melted. The body temperatures of the birds at the retail store ranged between 33° and 34° F. All the birds in the wirebound crates arrived in good condition.

Common types of crate failure involved split, cracked, or broken slats or cleats. However, these did not materially affect the performance of the container. In one shipment, serious damage was found in 12 percent of the crates. However, practically all the serious damage was attributed to poor loading practices in a single truck.

Trade Reaction

Some receivers thought that the wirebound crates were adequate, with no storage or drainage problems. However, many receivers complained that the crates were heavy, hard to handle, broke and splintered easily, and presented a disposal problem. Three of the more interesting comments were:

> A butcher in Sacramento: "I don't care for the wirebound crates--when they are placed on our sawdust floors, the sawdust seeps into the container and sometimes gets on the birds."
>
> A chainstore receiver: "It doesn't make any difference to me what container they use--we always unpack the crates as soon as we receive them and place the birds in a bin full of crushed ice."
>
> A small rural-area store manager: "I like the wirebound crates; they are easy to dispose of--all I do is throw the empty containers out in the back and someone picks them up and hauls them away."

EXPERIMENTAL WIREWORK BASKET

Summary of Development Work

Surveys indicated that the use of a "returnable" container for shipping fresh ready-to-cook poultry to nearby markets was economically feasible. Researchers therefore investigated various types of materials such as wood, plastics, and fiberboard. They finally decided to construct a returnable basket-type container from rolled steel rods and heavy steel wire. This basket was to be used with a low-cost disposable liner.

The first design could be stacked but not nested. The second design could be stacked and nested. The third design incorporated all the improvements made in the previous models, but was further refined so that it was stronger and had a greater ratio of functional capacity to overall size of the container. A list of the modifications and improvements developed during the design and testing program and incorporated in the final design follows:

1. A disposable polyethylene liner was designed to permit drainage and to protect the birds from contamination from outside sources.

2. A sheet metal plate was spotwelded in the bottom of the basket to protect the fleshy portions of the bottom-layer birds.

3. Sides and ends were sloped to permit nesting.

4. "Flop-over" handles were developed to allow stacking of full baskets; they folded out of the way for nesting empty baskets.

5. A metal card holder for labels with identifying information about the contents was attached to one end of the basket.

6. The lengthwise strands of the grid were placed on the inside of the basket to facilitate insertion of the handtruck noseplate.

7. Rods of heavier gage were used in the frame to extend the useful life of the baskets.

8. Dimensions were changed to improve the stacking stability, facilitate handling, and increase the useful cubic capacity of the baskets.

Description of Final Design

The returnable basket consists of a sturdy wirework grid hung from a rectangular frame formed by a 5/16-inch rod of cold rolled steel (fig. 3). Three auxiliary frames of heavy 4-gage wire reinforce the grid, which is spotwelded to the frames at every point of contact. The grid is of 9-gage wire.

Sides and ends of the basket flare outward 4½ degrees from the vertical to permit nesting. The main element of the handles is a 3/8-inch steel rod hooked at both ends. It is attached to the top frame at each end of the basket by four 3/16-inch rods, parallel to each other and perpendicular to handle and frame. The attachment to the frame permits the handle to swing out and down to allow nesting; and the handle can also swing inward to form a support on which other baskets can be stacked without exerting weight on the contents. Despite overhead pressure, the handles are held in a horizontal position by their hooked ends which fit over the sides of the top frame 3 3/4 inches in from the ends of the basket.

Full baskets usually were stacked 5 high; 20 empty baskets could be stored nested under an 8-foot ceiling.

A 28-gage steel sheet 13 1/4 by 20 1/2 inches was centered and welded inside the bottom of the basket to protect the bottom layer of birds from the grid. A label plate, also of 28-gage steel sheet, was welded to one end.

The basket had a functional capacity of 4,052 cubic inches and easily held 60 to 70 pounds of poultry and 25 to 30 pounds of crushed ice. Tare weight was 12 pounds.

The basket is 11½ inches high outside and has 10 5/8 inches of usable interior space beneath the supports formed by the turned-in handles. At the top, which is slightly larger than the bottom because of the flare, the basket is 23 3/4 inches long and 18 3/8 inches wide. The baskets were plated after fabrication.

Disposable Polyethylene Liner

To retain crushed ice inside the wire baskets and protect the poultry from outside contamination, the baskets were lined with a specially designed

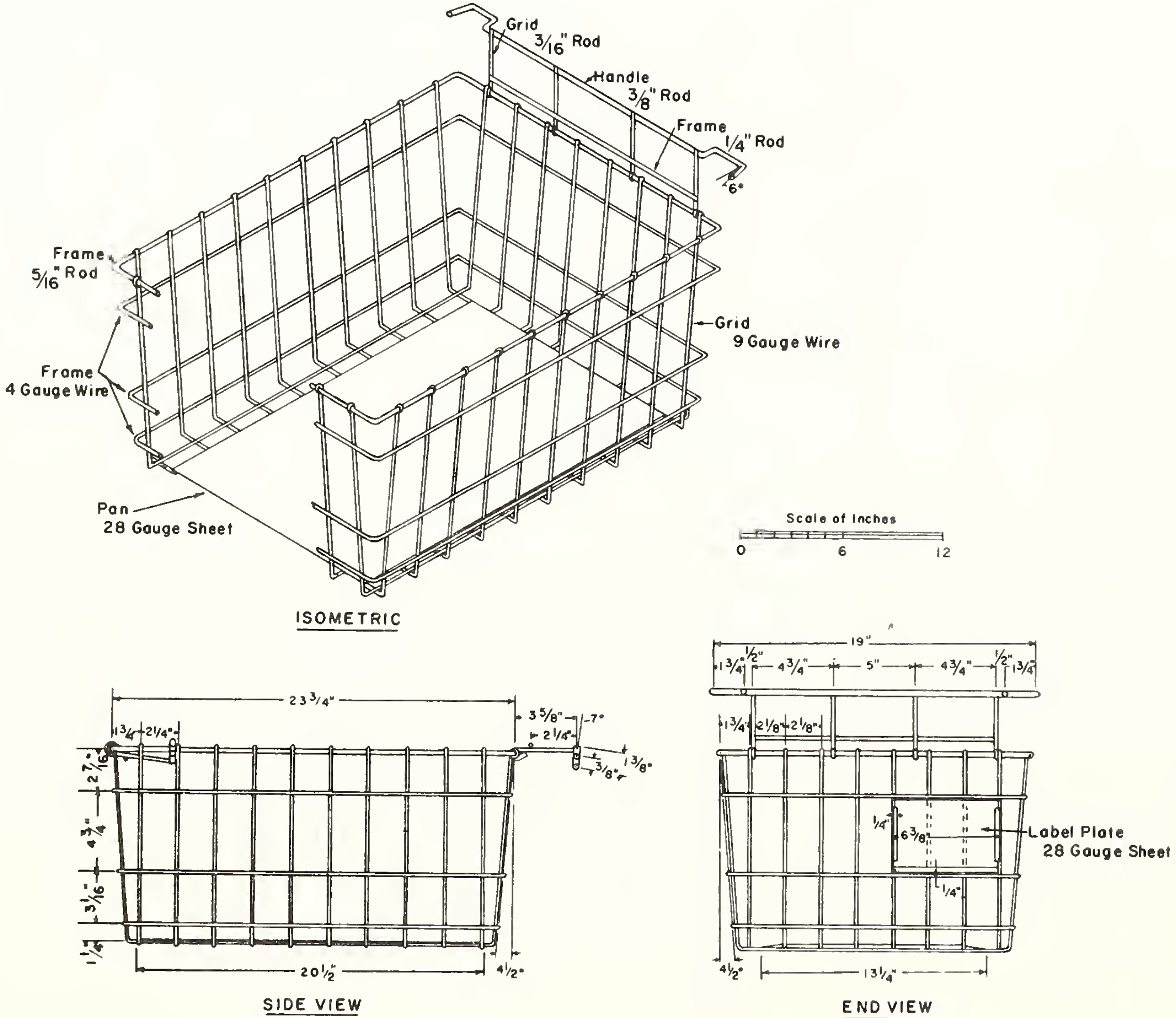

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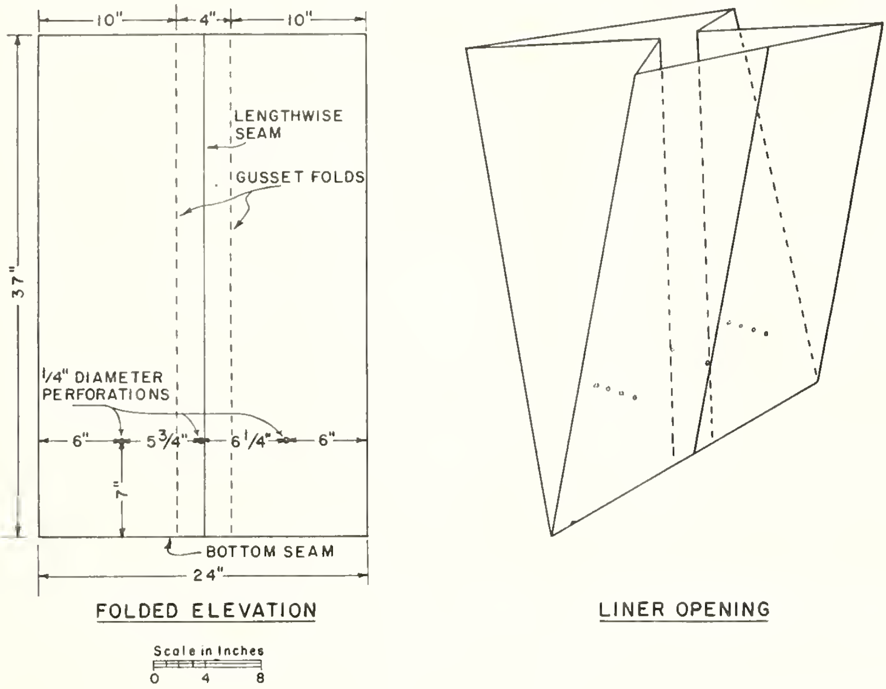
Figure 3.--Drawings of returnable wirework basket.

disposable bag constructed from 1½-mil medium-density polyethylene. The liner film measured 24 by 37 inches, with a 10-inch gusset, and was perforated on the bottom with 10 quarter-inch holes to allow drainage of ice water and body fluids from within the pack (fig. 4). Research indicated that this was the minimum number of perforations needed for adequate drainage, but that more perforations are not desirable because they increase the chances of entry of foreign material. The tops of the liners were closed tightly with paper-covered wire ties.



FOLDED ELEVATION

LINER OPENING

BN-17618

Figure 4.--Disposable polyethylene liner designed for use with basket.

Methods of Packing

Because these experiments were on a small scale, involving only 7 to 100 containers in any one plant, no special washing equipment was installed. The baskets were scrubbed with a solution containing a bactericide and detergent, then rinsed with very hot water. Discussions with equipment manufacturers indicated that it would be easy to install automatic washing equipment for large-scale operations.

Unlike the conventional crates, the wire baskets were delivered to the processing plant all set up and with no variation in weight. Hence, assembly of the container and weighing it empty to determine its tare were eliminated from the packing operation.

After the basket was washed, a polyethylene bag liner was inserted into each basket, which then was placed on a conveyor belt that carried it to the packing and weighing areas (fig. 5).

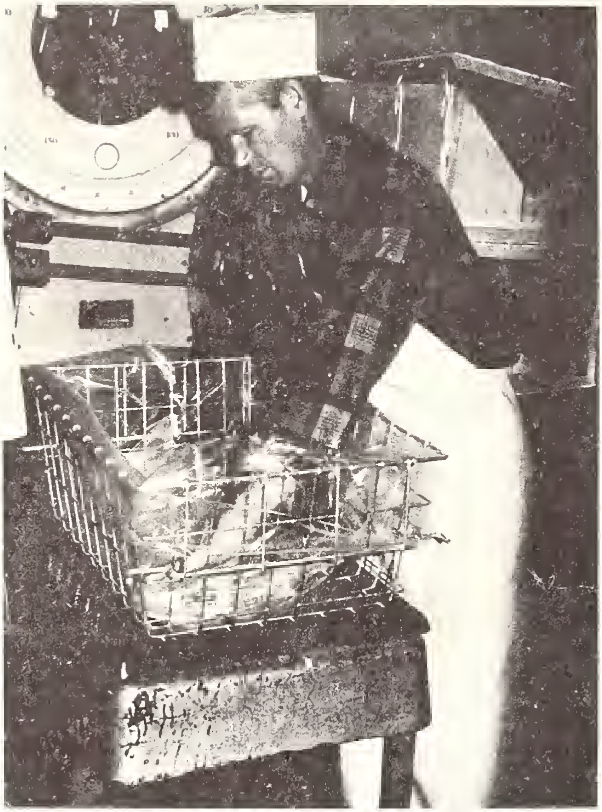


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Figure 5.-- Polyethylene liner is inserted in basket.

To protect the fleshy parts of the birds from grid indentations from the sides and ends of the wire baskets, a packing pattern was developed as follows: The birds were packed two layers deep, with the breasts up, in two crosswise rows per layer, with the neck of each bird facing toward the side grid walls of the basket, and legs interlocking at the center of the pack (fig. 6). Usually, from 20 to 30 birds were packed in each basket. Varying the count per basket according to the weight and size of the birds enabled the packers to utilize the basket capacity to its maximum.

Labels showing the net weight, count, grade, and size of the birds packed were inserted in the labelholder. The birds were covered with 25 to 30 pounds of crushed ice, and the tops of the plastic liners were gathered, twisted, and secured with a paper-covered wire tie. The baskets were then transported into the cooling rooms to await shipment.

The baskets were stacked on small wood pallets to raise them off the wet floors, usually found in poultry processing plants, and to protect them from damage by handtrucks (fig. 7).

Test Shipments

A series of 14 controlled shipments was made between January and December 1961, to determine the arrival condition of the birds and the experimental baskets. During this period, two basic basket designs were evaluated and many improvements and modifications were developed.

The baskets were transported from the processing plants to the retail stores in trucks of varying sizes. As a result, consistent loading patterns did not develop. However, the test baskets were usually stacked 5 high, lengthwise in the trucks, 4 or 5 wide, making a total of 20 to 25 baskets per stack. The baskets were loaded and unloaded manually, as are the conventional wirebound crates. The truck drivers generally found the wirework baskets more difficult to handle than the crates. The returnable baskets had to be carefully placed in position when they were loaded and unloaded. In contrast, the wirebound crates were loaded in any position, tumbled into and out of stack position, and pushed or dragged across the truck floor.

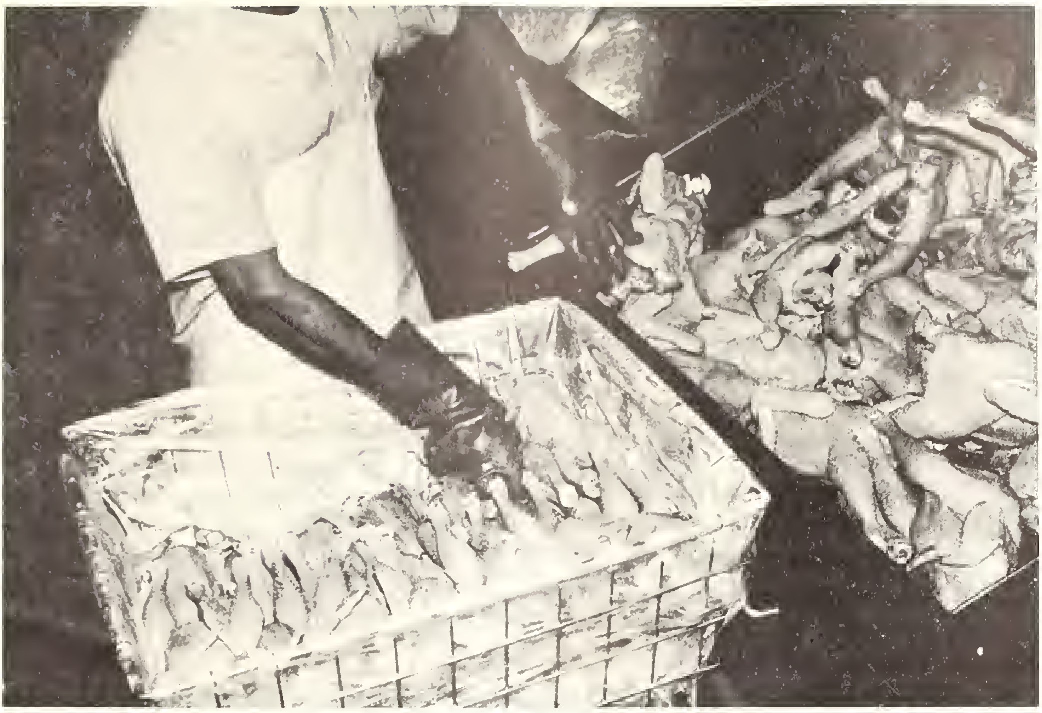

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Figure 6.--Chickens from bin are packed in baskets.

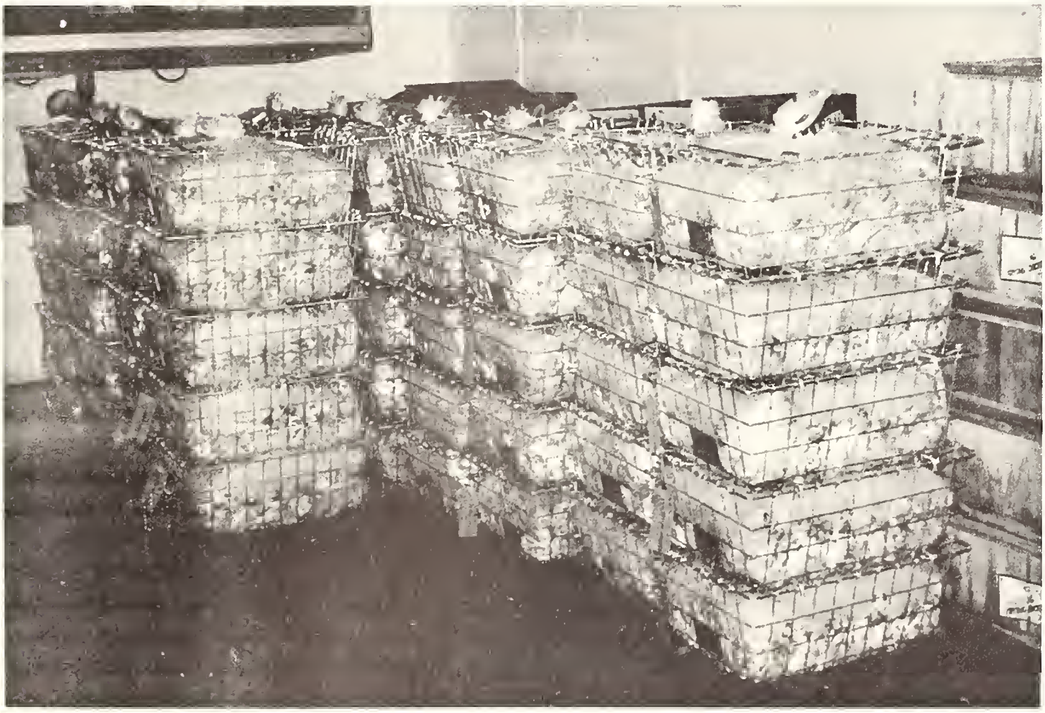

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Figure 7.--Baskets are stacked on pallets in cooling room.

Inspections in the retail stores showed that the birds packed in the wire baskets arrived in good condition, with no skin cuts or tears or disjointed or broken bones. Body temperatures of the birds ranged between 33° and 34° F. upon arrival.

Commercial test shipments to determine the basket life expectancy of the final design were begun in December 1961. When this report was written the wire baskets had completed an average of 35 round trips. Examination of the baskets revealed that they were in good condition, with no signs of major damage or weakness. After 35 trips, it was noted that the standard commercial plating (.0003-inch minimum) had worn off some portions of the bottom areas of the basket. This could be largely overcome by doubling the thickness of the plating, at a cost of 20 cents per basket.

What the useful life of the baskets may be depends upon such variables as the distances baskets are shipped and the methods employed in handling them in the plants and in the retail stores. Examinations after 35 completed trips indicated that the wire baskets should have an average life expectancy of at least 50 trips. For purposes of comparison, the costs of wire baskets, presented in this study, have been calculated on life expectancies of 25, 35, and 50 trips.

The polyethylene liner was strong enough to withstand both normal use and abuse. In one test, researchers tipped fully packed liners from the baskets. In no case was there a failure of liner or tie.

Trade Reaction

The trade reaction to the wire baskets was very favorable. Several receivers said that they liked the baskets because they were more sanitary, since drainage from containers stacked above could not leak into the lower baskets. Butchers also commented that the baskets were easy to "work out of"--meaning that they could wheel a shopping cart next to the basket and easily tear open the polyethylene liner and unpack the chickens into the cart.

When the butchers were asked if they had any space problems in storing empty baskets, the majority said that the baskets nested very well, and there was no space problem. One meat buyer, representing a large chainstore organization, liked the wirework baskets so well that he instructed all his butchers to take good care of the baskets and protect them from loss.

Some butchers said that, when they had poultry specials, they would not have room to store all the empty baskets within the store and would have to store them outside. They said that they did not want to be responsible for the baskets under those conditions.

Controlling Return of Containers

The utility and economy of these containers depends to a great extent on the amount of control the processor exercises over their use and return to the plant.

To minimize losses and to maintain a rapid turnover of the containers, potential users should consider the following:

1. The returnable baskets should be shipped only to regular customers.

2. The baskets should have the name of the shipper stamped on the bottom plate and on the card holder.

3. Where possible, the names stamped on the baskets should be registered with State authorities so that it would be illegal for others to use them.

4. The truck drivers should be trained to pick up the empties every time they deliver to the stores. Followup supervision also is important.

5. Meat merchandisers of supermarket chains should be informed about the use of these containers.

An advantageous practice is to have a statement printed on the invoice ticket indicating the receipt of these returnable containers. These receipts can usually instill in the retail butchers a sense of responsibility without a threat of monetary loss.

MOISTURE-RESISTANT FIBERBOARD BOXES

Several manufacturers have recently developed facilities for the production of fiberboard impregnated with waxes or with waxes combined with other materials, and are offering moisture-resistant boxes to shippers of icepacked commodities.

Four designs of these boxes, made by two firms, were selected for evaluation. On the first trial, it was apparent that one box did not protect the chickens adequately. It was withdrawn by the manufacturer and redesigned, but the improved model was not completed in time for a full test series. Dimensions and specifications of the other three boxes evaluated are listed in table 1.

Closure and Drainage Features

One-piece regular slotted container.--This box was closed by folding side flaps over end flaps. The end flaps did not meet, but the side flaps did. A quarter-inch by 1-inch slot for drainage of fluids was at the bottom of each end panel.

One-piece container with interlocking top.--The top side-flaps, which were closed first, had a 3½-inch overlap. The overlapping portions were scored to permit folding and interlocking opposite flaps. The two end-flaps, with a 1-inch overlap, were folded down over the side flaps and stapled or banded (fig. 8). A ¼-inch hole in the center of the bottom of each end panel provided drainage.

Full-telescope container.--This box had a modified full-telescope cover with no joint on the top surface--all joints were on the ends (fig. 9). Four round holes 3/4 inch in diameter, for drainage, were at the junction of the side and bottom panels at points 2 inches in from the end panels of the cover, matched with grooves in the inner case to provide handholds.

The amount of poultry packed in the fiberboard boxes varied somewhat, but the averages observed are listed in table 1. The birds in each box were usually covered with 15 to 20 pounds of crushed ice. Twenty pounds of ice on 60 pounds of poultry was generally considered the minimum required under most conditions, but 15 pounds was adequate for local deliveries. When additional amounts were needed in the telescope box, ice could be heaped up to an inch above the top of the inner case. The ice began melting and settling in a short time. Hence, when the boxes were loaded into trucks for delivery, the covers were down in place.

Table 1.--Description and specifications of moisture-resistant fiberboard containers, California, 1961

Type of container	Inside dimensions	Bursting strength 1/	Tare weight	Capacity	Weight of birds packed 2/
	Inches	PSI	Pounds	Cu. In.	Pounds
One-piece regular slotted container...	21x15x10	275	4.0	3,150	60
One-piece container with interlocking top flaps..........	19x14x11	275	3.7	2,926	55
Two-piece container with modified full-telescope top.......	20½x15 1/8x9½	250	3.5	2,946	60

1/ This was a test of the board before it was impregnated.
2/ Average packed by processors.

Methods of Packing

The experimental fiberboard containers were packed on commercial packing lines normally used for wirebound crates. The methods of filling, weighing, and top icing them were basically the same as the methods used for the conventional crates, but operations such as assembling, tagging or marking, and closing were different.

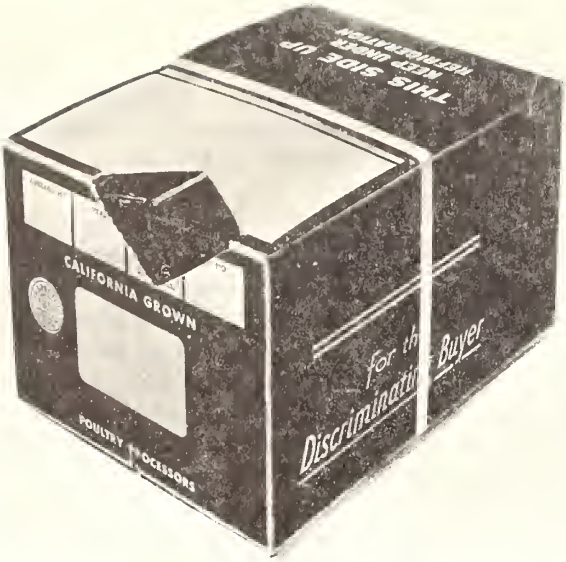

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Figure 8.--Wedges have been cut from one end wall and end flap to show interlocking side flaps of this fiberboard box. End flaps have been folded down over side flaps and banded to close.

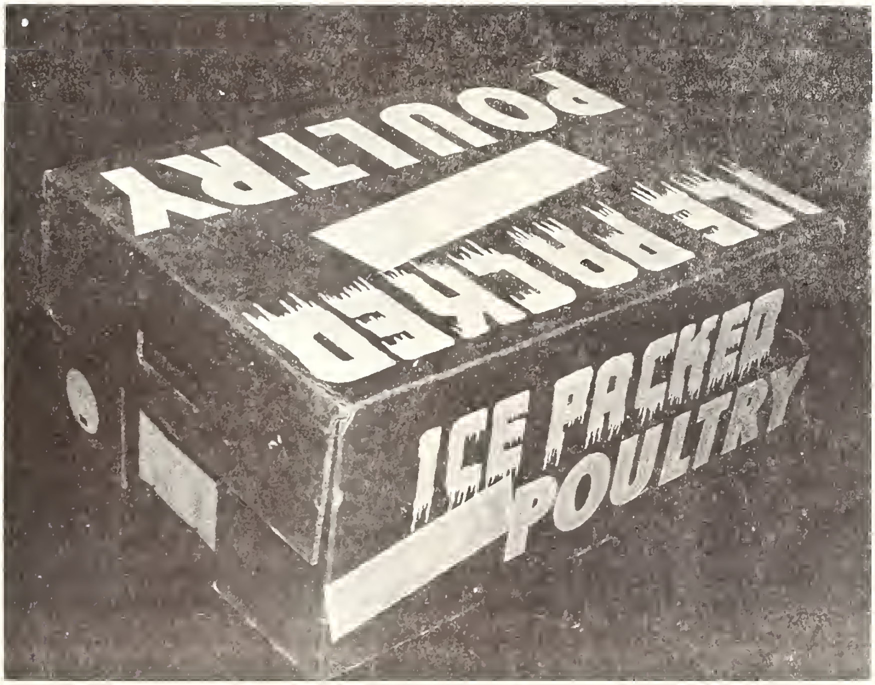

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Figure 9.--Top surface of telescope box is unbroken by seams or joints.

All three types of fiberboard containers were assembled with a semiautomatic stapling machine (fig. 10). However, when the one-piece container with interlocking top was being packed for special shipments to canneries, the containers were not assembled with staples, but were formed and packed, and then closed with 3/4-inch steel strapping that secured the bottom and top flaps. This eliminated any possibility of loose staples contaminating the processed food.

Usually 24 birds of mixed sizes were placed in each container. The count, net weight, and grade of the birds were marked by crayon on blank labels printed on one end panel of each box (fig. 11). The containers were iced, then closed as follows:

The regular slotted container and, generally, the box with interlocking top flaps were stitched with a hand stapler. The telescope box was closed simply by fitting the preassembled cover over the filled inner case.

The box with interlocking flaps and the telescope box were moved to the holding rooms and stacked five high on pallets. The regular slotted container was usually handtrucked directly to the loading dock.

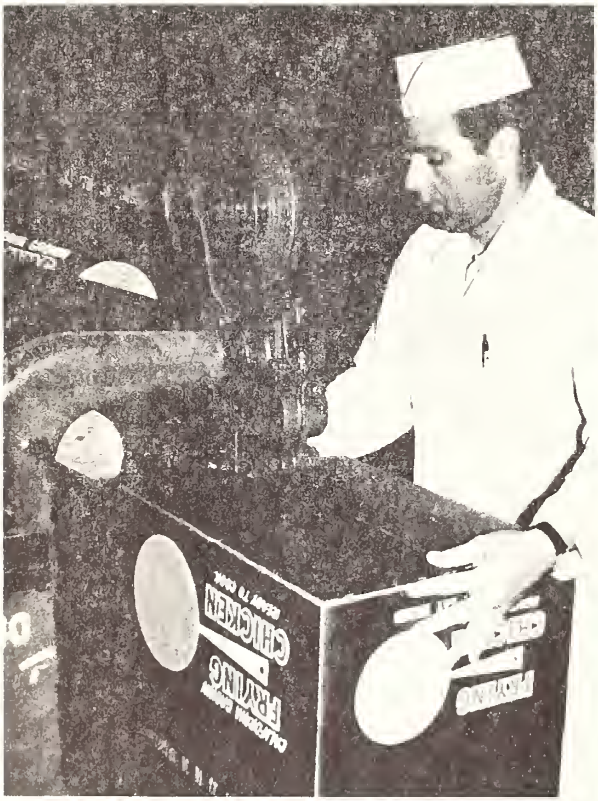

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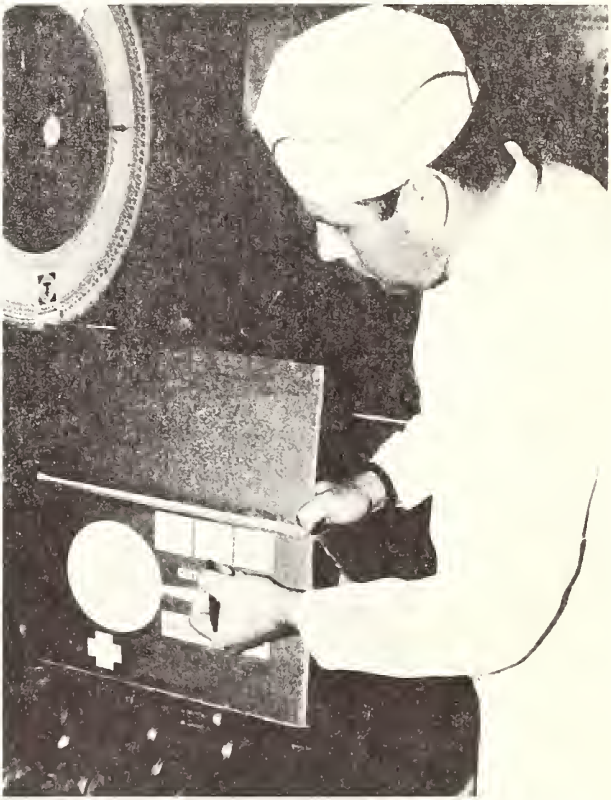
Figure 10.--Regular slotted container was assembled with stapler.



BN-16998

Figure 11.--Printed box end labels facilitate identification marking.

Test Shipments and Trade Reaction

Regular slotted container.--The one-piece regular slotted container was used primarily for shipping icepacked poultry to local markets. Researchers observed two test shipments that traveled approximately 50 miles each from the processor to the last store on the delivery route.

The one-piece fiberboard containers were packed and loaded directly on trucks for immediate shipment. The elapsed time between packing of the containers and arrival at the most distant retail outlet was about 3 hours. Since the containers were in use for a very short time, these tests were not strenuous. However, it was noted that the container did not prevent the entrance of fluids from boxes stacked above. In transit, the container covers sagged, forming depressions in which water accumulated, aggravating the problem of preventing the entrance of fluids.

Upon arrival at the stores, the body temperatures of the birds ranged between 33° and 35° F., and the tare weight of the containers had increased from 4.0 to 4.5 pounds.

The receivers liked the regular slotted container. They agreed that the containers were easy to handle, and that they were adequate for short shipments. The performance of this container in shipments of more than 50 miles was not determined.

One-piece container with interlocking top flaps.--Two test shipments of the container with interlocking top flaps were made. Two methods of closing and interlocking the flaps were tested to determine which method was better in preventing the entrance of ice water and body fluids.

In the first test shipment, the top end flaps were first folded and then the top side flaps were folded over them and interlocked. The flaps were then secured by banding with 3/4-inch strapping. This method greatly reduced the quantity of foreign fluids entering the containers; only small amounts leaked into most containers. Again, slightly sagging tops resulted in an accumulation of water on the tops of the boxes.

In the second test, the side flaps were first folded and interlocked, and then the end flaps, which had been lengthened by one inch, were stapled together. Two-thirds of the containers inspected showed no leakage, and the rest showed only small amounts.

During an elapsed time of 97 hours, the average tare weights of the containers increased from 3.7 pounds to 4.6 pounds and the ice melt was over 60 percent. The temperatures recorded at shipping point and at destination were the same, 34° F. No product damage to the birds was noted in either test. The containers arrived in good condition with only slight amounts of top and bottom sag.

The receiver commented that the test containers were satisfactory. Since these tests, the Poultry Division of USDA's Agricultural Marketing Service, has approved use of the one-piece container with interlocking top flaps for nearby shipments.

Two-piece fiberboard box.--The telescope container was another developmental step in the effort to eliminate entrance of fluids and to increase the strength of the fiberboard shipping containers. Only one test shipment was needed to show that the cover, without a top joint, eliminated the entrance of fluids.

The test boxes were packed and held for 8 hours in a refrigerated storage room, then loaded on a refrigerated truck and shipped 450 miles. The truck was delayed in transit and did not arrive at destination until 30 hours after departure.

The containers arrived at delivery points in good condition. A few containers developed a slight sag in top and bottom. Melted ice and body fluids accumulated in the depression formed by the bottom sag. Although there were four drainage holes around the bottom edge, there was no outlet in the center of the bottom where the sag occurred, and the seamless construction of the bottom prevented seepage. Occasional minor creasing and crushing of corners were observed.

The birds arrived in good condition and had an average temperature of 34° F. However, about 65 percent of the ice that had been originally packed in the containers (16 to 18 pounds) had been melted, so that on arrival only 6 to 8 pounds of ice remained. The tare weight of the containers increased from 3.4 to 4.1 pounds.

When the truck arrived at destination, the poultry in the new containers was distributed to three retail stores. The butchers who handled these packs said they liked them very much. Typical comments were that they were "easy to handle;" had "very attractive printing;" and were "easy to open." All said that "this was the best designed container for keeping out drainage and foreign matter."

However, the distributor and the retailers said that the box would have to be enlarged so that the ice capacity could be increased to 25 or 30 pounds and the meat capacity to 65 pounds.

COOLING RATES AND WEIGHT LOSSES

Researchers recorded temperatures of the poultry at 2-hour intervals in the chilling room after packing and icing in three types of containers: Conventional crates, returnable baskets, and one-piece fiberboard boxes (tables 2 and 3).

Birds in the fiberboard boxes cooled a bit more slowly than in the conventional crates; birds in the returnable baskets cooled somewhat faster. Bottom-layer birds cooled more slowly than top-layer birds in all containers, particularly in the fiberboard boxes. After 12 hours in refrigerated holding rooms, poultry in all three containers cooled from a 40-degree temperature at packing time to a normal 33 to 35 degrees for shipping.

Table 2.--Comparative cooling rates of iced poultry packed in wirebound crates and in fiberboard boxes, April 1961

Time of recording temperatures	In cooling room	Wirebound crate		Fiberboard boxes	
		Top layer	Bottom layer	Top layer	Bottom layer
	° F.	° F.	° F.	° F.	° F.
4 p.m. (at packing)	---	40	40	40	40
6 p.m.	40	34	36	35	40
8 p.m.	34	34	36	34	38
10 p.m.	32	34	36	34	37
Midnight	32	34	36	34	36
2 a.m.	32	34	35	34	36
4 a.m.	33	34	35	34	35

Table 3.--Comparative cooling rates of iced poultry packed in wirebound crates and in wirework baskets, June 1961

Time of recording temperatures	In cooling room	Wirebound crate		Wirework basket	
		Top layer	Bottom layer	Top layer	Bottom layer
	° F.	° F.	° F.	° F.	° F.
4 p.m. (at packing)	---	40	40	40	40
6 p.m.	36	36	38	33	36
8 p.m.	34	34	36	33	34
10 p.m.	33	34	35	33	34
Midnight	35	34	35	33	34
2 a.m.	37	34	35	33	34
4 a.m.	38	34	34	33	34

Efforts to determine a method of accurately forecasting how much weight the birds might lose in different containers, between packing and delivery, were unsuccessful because of inability, under commercial conditions, to control all variables which influence moisture loss. Variation of the data obtained was so great that it was impossible to compare the effect of different containers on the amount of shrinkage.

Most of the California processors interviewed anticipated weight losses between 1½ and 2½ percent on deliveries of less than 200 miles, and they overpacked accordingly. Average findings of the researchers indicated that these estimates were, for the most part, realistic. However, chickens in a few boxes lost more than 3 percent of their weight and in a few boxes they gained. Weight increases have been attributed to ice adhering to the birds. [4]

COMPARISON OF COSTS

Containers and Packing Materials

Costs of containers and accessory packing materials for the four types of experimental shipping containers and the conventional wirebound crate are listed in table 4. The costs are based on quotations from packers and manufacturers.

Initial cost of the wire basket was $4. However, the table shows costs per trip, based on 25, 35, and 50 round trips between packing plant and retailer. At the time this report was being prepared, the test baskets had completed an average of 35 round trips and were still in good condition. Hence, costs at this level of use are singled out for discussion in this section of the text.

Materials and the container to pack 100 pounds of poultry in the conventional crate cost 43.7 cents more than materials and the container to pack the same weight in a returnable basket capable of making 35 deliveries. As the per-trip cost of the basket declines with increased usage, the cost of the polyethylene liner, which is discarded after each delivery, assumes relatively greater importance.

Costs of the experimental fiberboard containers ranged from 11 cents lower to 3 cents higher than those of the conventional crate, per 100 pounds of poultry packed.

Direct Labor to Pack

The direct labor required to pack poultry in the conventional crates and in the four types of experimental containers is shown in table 5. Only direct packing operations were included. Operations such as slaughtering, eviscerating, and precooling the birds before packing were the same, regardless of the type of container being packed. Since the size and capacity of the containers varied, the labor requirements are presented by container and by equivalents of 100 pounds of birds.

The wire basket required the most time. The amount of labor required for filling, weighing, labeling, and icing the returnable baskets was approximately the same as that for the conventional wirebound crate. However, picking up the empty baskets for return to the plants and cleaning them before packing were additional operations that required about 1.31 man-minutes per 100 pounds net

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[4] Kotula, Anthony W., Thompson, James E. and Kinner, Jack A., Water Absorption by Eviscerated Broilers During Washing and Chilling, U. S. Dept. Agr. Mktg. Res. Rpt. No. 438, 11 pp. 1960.

Table 4.--Comparative costs of packing materials for packing 100 pounds of fresh poultry in conventional wirebound crates, experimental wire baskets, and moisture-resistant fiberboard containers, California 1961

Item	Conventional wirebound crate	Returnable wirework basket			Moisture-resistant fiberboard containers		
		25 trips	35 trips	50 trips	One-piece regular slotted container	One-piece container with interlocking top flaps	Two-piece modified full-telescope container
	Cents	Cents	Cents	Cents	Cents	Cents	Cents
Container	48.30	1/17.60	1/12.57	1/8.80	39.78	39.57	48.50
Assembling material:							
Staples	---	---	---	---	.40	.40	.40
Labels	0.70	0.70	0.70	0.70	2/	2/	2/
Liner materials:							
Paper	3.16	---	---	---	---	---	---
Polyethylene	---	10.30	10.30	10.30	---	---	---
Wing tags	5.14	5.14	5.14	5.14	5.14	5.14	5.14
Giblet wraps	4.15	4.15	4.15	4.15	4.15	4.15	4.15
Closing materials:							
Staples	---	---	---	---	.64	.64	.40
Wire ties	---	0.17	0.17	0.17	---	---	---
Total:							
Per container	61.45	38.06	33.03	29.26	50.11	49.90	58.59
Per 100 pounds	94.54	58.55	50.82	45.02	83.52	90.73	97.65

1/ Adjusted to allow for loss of 10 percent of containers.
2/ Labels printed on end panels were included in cost of fiberboard boxes.

Table 5.--Average amount of direct labor to pack 100 pounds of poultry in conventional wirebound crates, experimental wire baskets, and moisture-resistant fiberboard containers, California 1961 1/

Operating	Conventional wirebound crate (3 plants)	Returnable wire basket (1 plant)	Moisture-resistant fiberboard container		
			Regular slotted container (2 plants)	One-piece box with interlocking top flaps (1 plant)	Two-piece telescope container (1 plant)
	Man-minutes	Man-minutes	Man-minutes	Man-minutes	Man-minutes
Cleaning	---	0.50	---	---	---
Weighing container before packing	0.08	---	---	---	---
Assembling	.23	2/	0.26	0.26	0.50
Inserting liner	.23	.40	3/	3/	3/
Filling	.68	.68	.62	.60	.62
Weighing and labeling	.28	.26	.26	.26	.26
Icing	.20	.20	.20	.20	.20
Closing	4/	.42	.20	.20	.10
Stacking	.08	.20	.08	.08	.08
Returning 5/	---	.35	---	---	---
Total:					
Per container	1.78	3.01	1.62	1.60	1.76
Per 100 lbs. 6/	2.74	4.63	2.70	2.91	2.94

1/ Includes 15 percent allowance for fatigue and personal time.

2/ Assembled by manufacturer.

3/ No liners used.

4/ Closed by automatic machine; no direct labor required. Manual closing required .24 man-minute.

5/ Labor to pick up empty baskets for return to plant.

6/ Based on automatic closing with 65-pound net weight in crate and basket, 60 pounds in regular slotted and telescope containers, and 55 pounds in box with interlocking flaps.

weight of packed poultry. Inserting the polyethylene bag liners in the returnable baskets, gathering and twisting the liner tops and applying the paper-covered wire ties for closing, and stacking also required more labor. The liners had to be arranged so that the drainage holes in the liner were in position. Because they were awkward to handle, the wire baskets required more time to stack than the other containers. The labor required to pack 100 pounds of poultry in the returnable baskets amounted to 1.89 man-minutes more than in the conventional crates that were automatically closed. When the crates were closed manually, the difference was 1.52 man-minutes.

When the wirebound crates were closed automatically, as observed in the most efficient plants, two of the three types of fiberboard containers required slightly more direct labor to pack, and one, the regular slotted container, just a shade less.

Assuming a wage of $1.75 per hour, the direct labor cost to pack 100 pounds of dressed birds in the conventional crates was about 5½ cents less than for packing in the returnable wirework baskets (table 6).

Table 6.--Cost of direct labor and materials to pack 100 pounds of poultry in conventional wirebound crates and in experimental wire baskets and moisture-resistant fiberboard containers, California, 1961 1/

Item	Conventional wirebound crate	Returnable wire basket	One-piece regular slotted fiberboard container	One-piece container with interlocking top flaps	Two-piece full-telescope container
	Cents	Cents	Cents	Cents	Cents
Direct labor used at $1.75 per hour	2/8.0	13.5	7.9	8.5	8.6
Packaging materials ...	94.5	3/50.8	83.5	90.7	97.6
Total: Per 100 pounds	102.5	64.3	91.4	99.2	106.2

1/ Does not include supervision and equipment costs, depreciation, taxes, interest, insurance, or other overhead and fixed costs.

2/ Based on closing wirebound crates with fully automatic equipment.

3/ Based on 35-round-trip life; 25-round-trip cost would amount to 72.06 cents, and 50-trip life 58.53 cents.

The wirebound crates cost about the same for direct labor to pack 100 pounds as the one-piece regular slotted container (8.0 vs. 7.9 cents), and about a half cent less than the telescope box and the container with interlocking top.

Combined Materials and Direct Labor Costs

Comparative costs of materials and direct labor are combined in table 6. The combined costs for packing the three types of moisture-resistant fiberboard containers ranged between $0.91 and $1.06. The same costs for packing the conventional wirebound crates were approximately $1.02.

When the returnable wirework baskets were used, the costs per 100 pounds were reduced to approximately 64 cents per trip. This 38-cent saving per trip, compared to the cost for the crate, is based on a useful life of 35 round trips for the wire baskets. This saving would be increased to 44 cents if the useful life of the baskets increased to 50 trips.

DISCUSSION

Requirements for shipping containers for icepacked poultry are many and difficult to meet. The container must be able to hold 90 to 95 pounds of meat and ice. When in a stack, it must support an overhead weight of 500 pounds (with the containers out of alinement) while subjected to the stress of vibrations from all directions during transit by truck. It must keep the contents clean by preventing the entrance of foreign material, and yet must provide a method of draining ice water and body fluids from within. The container must be impervious to damage or softening by long periods of direct contact with fluids. It must be easy to store, assemble, pack, and handle. It also must satisfy the retail butcher, who wants a sanitary, attractive container that is easy to open and empty, or, as he puts it, "a box that is easy to work out of."

Conventional Wirebound Crate.--The outstanding virtue of the crate is its rugged construction. It holds up well in shipments of 2,000 miles and more under most unfavorable conditions. Constant exposure to liquids results in no adverse effects. A weakness was its inability to prevent the entrance of foreign material and of drainage from overhead. A film liner to eliminate this weakness would cost about 6 cents more than the paper liner; and processors were unwilling to assume this expense as long as receivers did not insist on it. Retailers were about equally divided on the ease of handling and on disposal of the crate. Some said these were not problems and some said they were.

Fiberboard Boxes.--With its seamless top, the full-telescope box, alone of the fiberboard boxes, completely prevented entry of seepage from containers stacked above it. The telescope box with handholes also was the easiest of any container to handle, and it was the strongest of the fiberboard boxes. The box with interlocking top flaps was quite resistant to the entrance of overhead drainage, but the one-piece regular slotted container performed no better than the crate. Tops and bottoms of all the fiberboard boxes tended to sag. None of the boxes was tested in shipments of more than 450 miles, so their performance at greater distances is uncertain. The cost of materials and direct labor to pack the telescope box was 4 cents higher per 100 pounds of poultry packed than the cost for the crate. The box with interlocking top flaps cost 3 cents less per 100 pounds than the crate, and the regular slotted container cost 11 cents less than the crate.

Returnable Wirework Basket.--This container was suitable for deliveries to regular customers in areas served by the processors' own trucks and drivers. Such areas observed in this study usually reached little farther than 125 miles from the plant. The basket, regularly returned, not only promised cost reductions of 30 to 40 percent, but also provided superior protection for the poultry against contamination from the outside. However, baskets needed more care in handling than crates.

It was estimated that one small processor who marketed 500 birds a day in his own community could save about $900 in 6 months by purchase and use of 60 returnable baskets. This estimate assumed that the baskets would make two trips a week or one every 3 working days for 26 weeks; it also included an allowance of 10 percent for possible basket losses or failures.

When this report was written, this processor had a set of test baskets which had completed 35 round trips. They were still in good condition and it was estimated they would withstand at least another 35 trips. Furthermore, the manufacturer reported he would repair and replate damaged baskets for $1.25 each. If all baskets were overhauled at the end of the first 6 months, it was estimated that container costs in the second 6 months would reflect a saving of $1,100 compared with costs with the conventional crates. Hence, it was estimated that savings in a full year should total $2,000.

A processor who marketed 30,000 birds a day was another cooperator in the evaluation of the returnable baskets. It was estimated that he could use the baskets advantageously to deliver the 30 percent of his output which was sold to regular customers within 125 miles of the plant. Test observations indicated that the experimental baskets made an average of one round trip in 4 days, because the distance between plant and customers was considerably greater than in the case of the small processor previously described.

For a single daily delivery of 9,000 birds to nearby customers, the processor would require 375 returnable baskets, or a total of 1,500 to carry over the 4 days needed for the round trips. With an average of 39 trips per basket, 58,500 deliveries could be made in the first 6 months at an estimated cost of $23,705, compared with an estimate of $38,984 for the same number of deliveries in the conventional crates. That would save approximately $15,000. Use of repaired and replated wirework baskets during a second 6-month period would result in estimated savings of $20,000, or a total saving of approximately $35,000 in a year.

Under similar conditions, a large plant with an output of 125,000 chickens a day might save almost $150,000 a year by using returnable baskets for an assumed 30 percent of customers within a delivery area of less than 200 miles.

Basket Improvements Probable.--Research workers did not believe that the fifth model of the basket, described in this report, was the final answer. They were confident that, once the basket went into commercial use, many improvements and refinements would be made. One recommended change is the addition of 3/8- to ½-inch legs to raise the basket off the floor. Although inspections at delivery points did not reveal a single instance of foreign material penetrating the polyethylene liner through its drainage outlets, sanitarians suggested that the addition of legs would provide double insurance against contamination from floors of trucks, loading docks, warehouses, or stores where pallets were not used.

The test baskets were larger than normally would be needed. They were made to hold 30 to 35 pounds of ice in addition to 65 pounds of poultry, at the request of cooperators whose processing plants were in the San Joaquin Valley where temperatures of 105 degrees were not uncommon. Processors in cooler areas could safely reduce the size of the basket by 200 to 400 cubic inches.

It may be possible to lower the cost of the 10-cent polyethylene liner, which is discarded after every trip of the basket. Large-scale purchases of the polyethylene bags in roll form would be less expensive. Additional economies might be gained by using film of lower density. Such film is tougher, although cloudy. The transparency of the film used in the tests served no essential purpose at either processing plant or point of delivery.

Future Trends and Promising Avenues of Development.--In recent years, there has been a trend toward smaller, more compact containers for agricultural products delivered to retail stores, even though, at the same time, larger pallet boxes, which can be handled by mechanical equipment, are gaining favor for delivery of some of the less perishable commodities to processors and other large users. The conventional crates for poultry weigh between 90 and 95 pounds when packed, and are difficult to handle. So far, processors have resisted all suggestions for 1/2- or 2/3-size containers. Fiberboard manufacturers are increasing their efforts to develop suitable light weight containers for the poultry industry. As their technology in the production of moisture-resistant fiberboard improves, the possibilities of providing 1/2- or 2/3-size boxes at a competitive cost should not be ignored.

The plastics industry has made great strides in the development of molding techniques for high-speed, low-cost production of large objects. There are a number of plastic materials that would be suitable for construction of reusable containers. Molding with plastics gives the designers considerable flexibility. For example, it should be possible to design a container with a locking cover, to eliminate the need for a liner or to permit the use of a very cheap liner. Several manufacturers are supplying the retail produce, beverage, and meat trades with plastic reusable containers.

Use of flexible containers, such as bags, for poultry would probably result in the lowest possible cost. The dynamic packaging materials industry is rapidly developing new types of flexible materials. Kraft papers coated with polyethylene film seem to have good possibilities.

Considerable developmental effort, testing, and evaluation research are needed in these promising areas.

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